Appendix E
Waste Management

E.1 OVERVIEW

This appendix provides a general overview of the Department of Energy (DOE) environmental restoration and waste management program including the categories of waste streams managed by the Department; the applicable Federal statutes and DOE Orders; waste minimization and pollution prevention; waste treatment, storage, and disposal; transportation of wastes; and facility transition management. Current site-specific waste management activities will follow in Section E.2. Project-specific waste management activities are addressed in Section E.3.

E.1.1 WASTE CATEGORIES

Wastes are generated in gaseous, liquid, and solid form and are categorized by their health hazard and handling requirements. The categories are listed in Table E.1.1–1.

Table E.1.1–1. Waste Categories

Category	Characterization
Spent nuclear fuel	Nuclear reactor fuel that has been irradiated to the extent that it has undergone significant isotopic change to the point that fission-product poisons have reached an uneconomic threshold. DOE is no longer reprocessing spent nuclear fuel solely to recover fissile and fertile material. Although spent nuclear fuel is not categorized as a nuclear waste, the definition is provided here since it is radioactive material that must be stored, managed, and handled.
High-level (HLW)	Highly radioactive material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid waste derived from the liquid that contains fission products in sufficient concentrations; and other highly radioactive material that the Nuclear Regulatory Commission (NRC), consistent with existing law, determines by rule to require permanent isolation.
Transuranic (TRU)	Radioactive waste that is contaminated with alpha-emitting elements with an atomic number greater than uranium, half-lifes greater than 20 years, and in concentrations greater than 100 nanocuries per gram (nCi/g). Such wastes result primarily from fuel reprocessing, and from the fabrication of Pu weapons components and Pu-bearing reactor fuel. Generally, little or no shielding is required ("contact-handled" TRU waste), but energetic gamma and neutron emissions from certain transuranic nuclides and fission-product contaminants may require shielding or remote handling ("remote-handled" TRU waste).
Low-level (LLW)	Radioactive waste that is not spent nuclear fuel, HLW, TRU waste, or byproduct material as defined by DOE Order 5820.2A, *Radioactive Waste Management.* Includes research and development fissionable test specimens with TRU waste less than 100 nCi/g. The radiation level from this waste may sometimes be high enough to require shielding for handling and transport. In 10 CFR 61, NRC defines four disposal categories of LLW that require differing degrees of confinement and/or monitoring: classes A, B, C, and Greater-Than-Class C.

Table E.1.1–1. Waste Categories—Continued

Category	Characterization
Hazardous	Nonradioactive waste that has characteristics identified by either or both of the following Federal statutes: *Resource Conservation Recovery Act* (RCRA) (40 CFR 261), as amended, or the *Toxic Substance Control Act*. These toxic, corrosive, reactive, or ignitable substances, or RCRA-listed wastes have been identified as posing health or environmental risks. Hazardous waste includes chemicals (such as chlorinated and nonchlorinated hydrocarbons), explosives, leaded oil, paint solvents, sludges, acids, organic solvents, heavy metals, and pesticides.
Mixed	Waste that contains both hazardous and radioactive constituents.
Nonhazardous (sanitary)	Solid sanitary waste that includes garbage, is routinely generated by normal housekeeping activities, and does not have a defined health risk (neither radioactive nor hazardous). Liquid sanitary waste includes sewage and industrial waste, and is treated in a wastewater process before discharge to a publicly owned treatment works or to surface waters. The management of liquid sanitary waste is regulated by the *Clean Water Act* and the National Pollutant Discharge Elimination System.
Nonhazardous (other)	Other wastes that do not have a defined health risk, such as process wastewater.

E.1.2 APPLICABLE FEDERAL STATUTES AND DEPARTMENT OF ENERGY ORDERS

Most of the regulations that govern the storage, treatment, and disposal of wastes were promulgated since the original Nuclear Weapons Complex (Complex) was established. In many cases, the technology available at the time the Complex was constructed does not meet current requirements for full compliance and, as a result, interim agreements have been made with the regulatory agencies. Through continuous upgrade programs, processes have been improved or added to meet the new regulations. Operations continue on the basis of using "best available technology" for facilities that were in operation before the regulation came into effect. In the siting and construction of new facilities, the intent is to meet current regulations and to reach the goal of maximum recycle, minimal waste generation, no liquid discharges to the surface, and treatment and stabilization of unavoidable wastes sufficient for long-term storage or permanent disposal either onsite or offsite.

In order to operate at most of its facilities, DOE has entered into numerous agreements with States and the Environmental Protection Agency (EPA) to address compliance issues concerning certain aspects of environmental regulatory requirements that have arisen due either to the age of DOE facilities or the uniqueness of DOE operations. For the most part, DOE facilities are in compliance with the major portion of all environmental regulatory requirements, and these compliance agreements address specific situations. At the same time, most of these compliance agreements include a commitment from DOE to achieve compliance with the specific requirement by a specified date and according to a schedule and milestones for achieving that compliance. These schedules and milestones are renegotiated on an ongoing basis as a result of changing budgets, additional environmental findings, and other factors. These agreements guide DOE activities at the sites under applicable environmental laws, regulations, and other standards. Compliance with the terms of these negotiated agreements is one of the highest DOE priorities. Site operations would be conducted consistent with commitments DOE has made and would make in these agreements. DOE would work with the regulators to amend existing agreements and to develop new agreements to ensure continued compliance. Under no circumstances would DOE's performance pursuant to any existing compliance agreement be compromised or diminished as a result of the proposed action.

The following summarizes the applicable Federal statutes and DOE Orders:

Atomic Energy Act. The *Atomic Energy Act* gives (AEA) DOE the authority to manage and regulate nuclear materials handled and generated at its facilities; however, DOE seeks to make its internal guidelines consistent with standards applied to commercial nuclear facilities regulated by the Nuclear Regulatory Commission (NRC). Pursuant to the AEA, DOE is committed to the practice of "as low as reasonably achievable" exposure to radiation from its operations whereby exposures and resultant doses are maintained as low as social, economic, technical, and practical considerations permit.

Resource Conservation and Recovery Act. The *Resource Conservation and Recovery Act* (RCRA) was passed in 1976 as an amendment to the *Solid Waste Disposal Act* of 1965. RCRA regulates the "cradle to grave" management (that is, generation, accumulation, storage, treatment, recycle, transport, and disposal) of hazardous waste, nonhazardous waste, underground storage tanks containing petroleum products and hazardous substances, and medical waste. Subtitle C of RCRA mandates that hazardous wastes be treated, stored, and disposed of in a matter that will minimize the threat to human health and the environment. To carry out this mandate, RCRA requires that owners and operators of hazardous waste treatment, storage, and disposal facilities obtain operating or post-closure care permits for certain waste management activities. RCRA defines the requirements for treatment, storage, and disposal facilities. Subtitle D of the law addresses the management of nonhazardous solid waste. Title 40 of the *Code of Federal Regulations* (CFR) implements the statutory provisions of RCRA. RCRA is a program that may be delegated to the States; such delegation has occurred for most States where DOE facilities are located.

Land Disposal Restrictions. The Hazardous and Solid Waste Amendments to RCRA enacted in 1984 required EPA to evaluate all listed and characteristic hazardous wastes according to a strict schedule and to develop requirements by which disposal of these wastes would be protective of human health and the environment. The implementing regulations for accomplishing this statutory requirement are established with the Land Disposal Restrictions (LDR) program. The LDR of RCRA (40 CFR 268) impose significant requirements on waste management operations and environmental restoration activities. For hazardous wastes restricted by statute from land disposal, EPA is required to set levels or methods of treatment that substantially reduce the waste's toxicity or the likelihood that the waste's hazardous constituents will migrate. After the LDR effective date, restricted wastes that do not meet treatment standards are prohibited from land disposal unless they qualify for certain variances or exemptions. EPA has promulgated standards for each of the five statutorily designated categories (40 CFR 268.31–35).

In addition to prohibiting disposal before appropriate treatment, land disposal restrictions prohibit any storage of land disposal restricted hazardous wastes (including mixed waste) except "for the purpose of the accumulation of such quantities of hazardous waste as are necessary to facilitate proper recovery, treatment, or disposal" (40 CFR 268.50). EPA has determined that storage of a hazardous waste pending development of treatment capacity does not constitute storage to accumulate sufficient quantities to facilitate proper recovery, treatment, or disposal.

Underground Storage Tank Provisions. The requirements for the facilities that use tank systems for storing or treating hazardous waste are outlined in 40 CFR 264, Subpart J. These requirements include the assessment of the existing tank system's integrity, the design and installation of new tank systems or components, and secondary containment. Hazardous wastes or treatment reagents are not placed in a tank system if they could cause the tank, its ancillary equipment, or the containment system to rupture, leak, corrode, or otherwise fail. Controls and practices to prevent spills and overflows from tank or containment systems are also required. Inspection requirements, procedures for response to leaks or spills, the disposition of leaking or unfit-for-use tanks, and closure and post-closure care requirements are also outlined in 40 CFR 264, Subpart J. Ignitable or reactive and incompatible hazardous wastes have special requirements.

Resource Conservation and Recovery Act Corrective Action Program. Hazardous waste permits require sites to institute corrective action programs for investigating and remediating Solid Waste Management Units. This program applies to all operating, closed, or closing RCRA facilities.

Federal Facility Compliance Act. The *Federal Facility Compliance Act* was passed in 1992. It waived sovereign immunity for Federal facilities and included provisions concerning DOE compliance with RCRA hazardous waste treatment for mixed waste. The *Federal Facility Compliance Act* requires DOE to have approved site-specific mixed waste treatment plans and related consent orders in place 3 years (October 1995) from the date of enactment in order to avoid the imposition of fines and penalties (except for sites already subject to a permit, agreement, or order addressing compliance with the RCRA LDR storage prohibition).

In an April 6, 1993, *Federal Register* (FR) notice (58 FR 17875), DOE published its schedule for submitting plans for treating mixed wastes for each facility at which DOE generates or stores mixed waste. Two interim versions of the plans were used to facilitate discussions among states and other interested parties. A subsequent consent order signed by the regulatory agency requires implementation of the final site treatment plan. For mixed waste for which identified treatment technologies exist, the plans provide a schedule for submitting permit applications, entering into contracts, initiating construction, conducting systems testing, starting operations, and processing mixed wastes. For mixed waste without an identified treatment technology, the plans include a schedule for identifying and developing technologies, identifying the funding requirements for research and development (R&D), submitting treatability study exemptions, and submitting R&D permit applications. In cases where DOE proposes radionuclide separation, the plans also provide an estimate of the volume of waste that would exist without such separation, and cost estimates and underlying assumptions. DOE will also prepare summary documents of the final plans to provide a national picture of DOE's technology needs and possible options for treatment of its mixed waste. The summaries will be provided to all states and made available to other interested parties.

Comprehensive Environmental Response, Compensation, and Liability Act. The *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA), as amended by the *Superfund Amendments and Reauthorization Act* (SARA) of 1986, provides liability, compensation, cleanup, and emergency response for hazardous substances (including radionuclides) released to the environment. The cleanup of inactive waste disposal sites is one of the major requirements of CERCLA. It provides for prioritization of cleanup actions (National Priorities List [NPL] or Superfund List). Federal Facility Compliance Agreements are negotiated with EPA and the State to coordinate CERCLA and RCRA compliance activities in comprehensive strategies. CERCLA also requires public participation in the selection of remediation alternatives. Title III of CERCLA further requires that the National Response Center (operated by the U.S. Coast Guard) be notified in the event that a non-permitted release of a reportable quantity of hazardous substance or radionuclide occurs. In the case of such a release, the National Response Center alerts the appropriate Federal emergency personnel who assess the event, formulate response, and notify cognizant local emergency agencies. SARA requires industries to report the hazardous substances used at their facilities to include reporting inventories of these substances.

National Contingency Plan. The National Contingency Plan is an implementation regulation that sets forth requirements necessary to comply with CERCLA and SARA. For every site that is targeted for remedial response action under Section 104 of CERCLA, the National Contingency Plan requires that a detailed remedial investigation/feasibility study be conducted. The remedial investigation emphasizes data collection and site characterization. Its purpose is to define the nature, extent, and significance of contamination at a site in order to evaluate, select, and design a cost-effective remedial action. The feasibility study emphasizes analysis of data and decisionmaking; it uses results from the remedial investigation to develop response objectives and alternative remedial responses. These alternatives are then evaluated in terms of their engineering feasibility, public health protection, environmental impacts, and costs. The remedial investigation/feasibility study leads to a decision that sets forth the method selected for remedial action to clean up the NPL site. Under the provisions of CERCLA, Federal facilities have the lead for CERCLA actions.

Toxic Substances Control Act. The *Toxic Substances Control Act* (TSCA) was enacted in 1976 to ensure that the manufacture, sale, storage, and disposal of toxic chemical substances do not present an unreasonable risk of injury to health or the environment. Its applicability to DOE sites deals principally with the management and disposal of polychlorinated biphenyls (PCBs), asbestos, and dioxin. The problem created by radioactively-contaminated PCBs, asbestos, and dioxin is that currently there is a limited capability to treat these materials. Although the concentrations of radionuclides are relatively low, approximately 2 million pounds of radioactively-contaminated PCBs and PCB-contaminated material are destroyed annually by the K–1435 TSCA incinerator at the K–25 site (K–25) at the Oak Ridge Reservation (ORR).

Clean Air Act. The original *Clean Air Act* (CAA) was passed in 1955 and was wholly replaced by the *Air Quality Act* of 1967, although the name *Clean Air Act* is still used. It was reauthorized in 1990. The CAA establishes air quality requirements and pollutant emission limits. The National Emissions Standards of Hazardous Air Pollutants (NESHAP) is a section of the CAA that sets air quality standards for air emissions such as radionuclides, benzene, beryllium, and asbestos. NESHAP regulations require the use of EPA-approved monitoring instrumentation, sampling methodology, calculations, and modeling for each Federal facility.

Clean Water Act. The *Federal Water Pollution Control Act,* as amended by the *Clean Water Act* (CWA) of 1977, establishes a Federal/State scheme for controlling the introduction of pollutants into the Nation's waters. The CWA created the National Pollutant Discharge Elimination System (NPDES) program. This program regulates nonradiological effluent discharges to ensure that surface water bodies meet applicable water quality standards. Each discharge point (outfall) is permitted through the NPDES program. The CWA also requires permits for stormwater discharges.

Safe Drinking Water Act. The *Safe Drinking Water Act* (SDWA) was enacted in 1975 and is designed to protect drinking water resources. Primary drinking water standards set by SDWA apply to drinking water "at the tap" as delivered by public water systems. Of equal significance is that drinking water standards are used to determine groundwater protection regulations under a number of other statutes. The SDWA requires DOE to meet drinking water standards and complete sample analyses for DOE supplied drinking water at its sites. It also imposes requirements on installation and maintenance of drinking water wells.

Department of Energy Orders. The primary DOE Orders governing waste management are the following:

- DOE O 231.1, *Environment, Safety, and Health Reporting.* Establishes environmental protection program requirements, authorities, and responsibilities for DOE operations for assuring compliance with applicable Federal, State, and local environmental protection laws and regulations, Executive Orders, and internal department policies. Requires the preparation of waste minimization plans that describe how waste minimization activities will be promoted and implemented.

  [Text deleted.]

- DOE O 460.1, *Packaging and Transportation Safety.* Establishes the requirements for the packaging and transportation of hazardous materials, hazardous substances, and hazardous wastes.

  [Text deleted.]

- DOE Order 5820.A, *Radioactive Waste Management.* Establishes policies and guidelines by which DOE manages its radioactive waste, waste byproducts, and radioactively-contaminated surplus facilities.

E.1.3 Waste Minimization and Pollution Prevention

Waste minimization is the reduction, to the extent feasible, of radioactive and hazardous waste that is generated before treatment, storage, or disposal of the waste. Pollution prevention fully utilizes source reduction techniques in order to reduce risk to public health, safety, welfare, and the environment, and environmentally sound recycling to achieve these same goals. Each DOE site is required to have a Waste Minimization and Pollution Prevention Awareness Plan. To report progress towards their goals in the plan, each site prepares an Annual Report on Waste Generation and Waste Minimization Progress. When planning for facilities to be constructed by 2010, it will be necessary to consider currently available technology while providing modular, flexible designs that can incorporate process improvements as they become available. In accordance with Executive Orders 12856 and 12873, and DOE policy, the facilities that would support the long-term storage or disposition of weapons-usable fissile materials would be designed for waste minimization with an overall operating philosophy of pollution prevention. This waste minimization program would contribute to decreases in waste treatment, storage, and disposal costs and lower health risks to workers and the public. Technical approaches are being sought to optimize the number of production operations required, increase the use of nonhazardous chemicals and environmentally benign waste-producing chemicals, increase the use of recyclable chemicals and materials, and implement the new design or redesign of existing processes and products. Some criteria useful in determining successful technology include improved processing yield, reduced quantities of scrap, reduced waste and processing of byproducts, reduced use of hazardous chemicals, positive return on investment, and continued product quality.

E.1.4 Waste Treatment, Storage, and Disposal

For the purpose of analyses, waste management activities that would support the Material Disposition Program are assumed to be per current site practice, although future management of the waste would be contigent in part upon decisions to be made in the Record of Decision (ROD) for the *Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (Waste Management PEIS [DOE/EIS-0200-D]). Any future waste management facilities that may be required to support the Material Disposition Program would be coordinated with any decisions resulting from the Waste Management PEIS and any respective site-specific *National Environmental Policy Act* (NEPA) documentation.

Treated waste is waste that, following generation, has been altered chemically or physically to reduce its toxicity or prepare it for storage or disposal. Waste treatment can include volume reduction activities, such as incineration or compaction, that may be performed on a waste prior to storage or disposal, or both. Stored waste is waste that, following generation (and usually some treatment), is being temporarily retained in a retrievable manner and monitored pending disposal. Disposed waste is waste that has been emplaced to ensure its isolation from the environment, with no intention of retrieval. Deliberate action is required to regain access to the waste. Disposed wastes include materials placed in a geologic repository and buried in landfills.

Waste that is staged for processing would be stored according to its characterization and form. The disposal of waste from fissile material storage and disposition facilities would be managed by the DOE Office of the Assistant Secretary for Environmental Management (EM). A facility for disposal of retrievable and newly generated transuranic (TRU) waste near Carlsbad, New Mexico, is planned. All surface facilities at the Waste Isolation Pilot Plant (WIPP) have been completed. To date, only portions of the underground excavations have been completed. The remaining excavation would be completed once the facility is operational. Once operational, WIPP would become a permanent disposal site. The total projected capacity of WIPP is 175,543 cubic meters (m^3) (229,602 cubic yards [yd^3]), of which 7,080 m^3 (9,260 yd^3) can be remote-handled. A supplemental environmental impact statement (EIS) is being prepared for the proposed continued phased development of WIPP for disposal of TRU waste. This supplemental EIS will analyze the impacts of waste storage, characterization, certification, processing or treatment, and loading at the generator sites. It will also discuss the impacts of transportation of TRU waste between the generator sites and WIPP. The impacts of waste disposal operations at WIPP will also be analyzed, including the impacts of waste receipt, waste package inspection, monitoring, emplacement, and subsequent activities associated with eventual closure, decommissioning, and institutional control of WIPP once disposal operations have been completed. Options for the interim storage of TRU waste are evaluated in the Waste Management PEIS. Yucca Mountain is a site being studied to determine its suitability for the disposal of commercial spent nuclear fuel and defense high-level waste (HLW). To date, no decisions to utilize either Yucca Mountain repository or WIPP have been made. The remainder of this section discusses some of the treatment, storage, and disposal options that may be utilized with the various waste streams from fissile material storage and disposition facilities.

Gaseous Waste. Gaseous wastes can be nonhazardous (for example, inert gases and air), hazardous (chlorinated hydrocarbon vapor and polyaromatic hydrocarbon vapor), or radioactive (for example, tritium and xenon). Hazardous gaseous wastes that are combustible may be incinerated to destroy the hazardous constituents, converting the combustibles into carbon dioxide and water vapor, while capturing any particulates that may result. When a particulate (ash) is contaminated with heavy metals, the end-product must be stabilized into an approved solid form suitable for disposal.

Gaseous radioactive wastes are held for interim storage in tanks; adsorbed on surfaces in filters, molecular sieves, or active beds; refrigerated and liquefied or solidified; or reacted to an aqueous solution. A minimal quantity of radioactive gas below the permitted limits will escape to the atmosphere because it is not possible to retain every atom of gas within the process with today's technology. The expected release of radioactive gases from the project alternatives is listed in Appendix M. Gaseous waste may be oxidized, mixed with other liquid wastes, or solidified in a stable form for long-term disposal. Reactive gases such as tritium are captured on reactive beds, in molecular sieves, or in cryogenic traps for recycling back to the process. Inert radioactive gases such as xenon and argon can be separated by cryogenic capture and held in storage tanks until they decay sufficiently to permit release. Gases that decay to metals can be captured on activated charcoal beds and held until they can be stabilized, packaged, and disposed of as solid waste. When sufficiently decayed, gases may be released to the atmosphere.

Liquid Waste. Liquid waste includes both wastewaters and nonwastewaters. Wastewaters are a mixture containing water together with organic, inorganic, or radioactive contaminants. Liquid radioactive wastes are processed according to their chemical nature and radiological sources and activities. Liquid wastes that meet release criteria in applicable regulations can be released at permitted discharge points. Where conditions permit, liquids can be processed and recycled to replace virgin feedstocks. Waste processing removes the hazardous or radioactive contaminants from the releasable or recyclable liquids. The largest volume of liquid radioactive waste is low-level waste (LLW), typically in aqueous solution from process operations. Some of this waste is contaminated with hazardous compounds such as solvents or resins, and the result is a liquid mixed waste. Liquid HLW would not be generated in fissile material storage and disposition facilities, but is part of the reference conditions at candidate sites where spent fuel or target processing was conducted. The desired final waste form for liquid wastes is a stable solid that is resistant to stresses from heat generation and from internal and external physical loads. The form must remain stable while stored and not allow the radioactive constituents to migrate to the surroundings.

Mixed waste often has combustible constituents. These are most readily decomposed in thermal treatment (incineration) or chemical reaction resulting in the creation of an ash. The resulting material would be granular and suitable for stabilization in a cemented form in which the hazardous constituents (radionuclides and heavy metal compounds) are bound in compounds that have an affinity for heavy metals and radionuclides. These processes have been utilized in various forms, and their retention properties have been credibly demonstrated.

Liquid LLW is normally processed to reclaim or remove the excess water, leaving a saturated salt solution. This can be accomplished by clarification processes normal to water treatment, or by evaporation. This usually results in the greatest volume reduction for liquid waste. The subsequent stabilization and solidification of the concentrated solution results in a waste form that does not leach its active constituents for a time sufficient to allow the radioactive constituents to decay.

A method for stabilizing HLW for disposal is to process it into borosilicate glass casts within stainless steel cylinders. These are shock-resistant, elastic forms suitable for permanent disposal in an engineered repository. They also provide excellent retention during interim storage. In the preferred practice, the liquid waste stored in large tanks is pumped directly into the vitrification process where the liquid would be evaporated and the remaining salt would be fused with borosilicate into the glass waste form. In some processes (that is, at Idaho National Engineering Laboratory's [INEL] Idaho Chemical Processing Plant [ICPP]), the waste would be evaporated to calcine which is stored in a granular form for later processing. The disadvantage of this process is that airborne particulate matter is generated when the product is handled. The advantage is that the calcine can be stored safely in a stable form until it can be vitrified.

Liquid radioactive and hazardous wastes are usually stored in tanks where they are staged for further processing. Processes are employed to concentrate the hazardous constituents. These processes result in very significant volume reductions, with the reclaimed water processed to a purity sufficient for permitted discharge or recycle.

Liquid hazardous waste concentrates may contain combustive hydrocarbons and heavy metal contaminants. These can be treated by incineration to produce a dry waste. If this waste is still hazardous after treatment, it then can be processed into a stabilized solid that would not leach its hazardous constituents while in storage or in a disposal facility. Liquid low-level and noncombustible hazardous waste can also be processed into a stabilized solid form for storage and disposal.

Solid Waste. Solid radioactive wastes typically consist of contaminated materials (for example, filters, clothing, storage vessels, cleaning materials, and tools) that have been used in, or contaminated by, nuclear materials processing. The term is also applied to those stabilized forms resulting from gaseous or liquid waste processing. In solid waste handling, forms and materials would be segregated, combustibles could be incinerated, and the resultant materials would be reduced in volume, stabilized if necessary, and packaged in specified containers for storage or disposal.

HLW is stored at three of the sites considered for fissile material storage and disposition. It is stored as calcine granules at INEL in underground vaults, as liquids in tanks at Savannah River Site (SRS) and Hanford Site (Hanford). It would be processed to a glass/ceramic (at INEL) and borosilicate glass (at SRS), stored in an engineered facility onsite, and eventually shipped to a Federal repository.

Dry LLW that consists of protective clothing, containers, process materials, and equipment is stored in specified containers designed to retain the waste constituents for a time sufficient to permit decay of the radioactive constituents.

Solid hazardous wastes may contain combustible hydrocarbon compounds or mixtures with heavy metal contamination. These wastes are usually shipped to RCRA-permitted commercial facilities where they are treated, if required, and disposed of. Wastes that retain their hazardous constituents after processing must be packaged into forms that would retain the hazardous constituents safely within the waste form. For LLW or hazardous waste that results from liquid waste processing or incineration, the accepted form is solidification with a cement-like bonding agent.

Some mixed waste can be processed to remove its hazardous constituents and be disposed of as LLW. Otherwise, it can be processed into stabilized forms and packaged for storage in an engineered facility until a licensed facility is available for permanent disposal. Solid nonhazardous wastes from process wastewater evaporation ponds or from sanitary waste treatment plants are usually deposited as sludge in a landfill.

All DOE sites under consideration for fissile material storage and disposition facilities, except Pantex, either have or have planned an onsite LLW disposal facility. For the purposes of this programmatic environmental impact statement (PEIS), it was assumed that all LLW generated at the Pantex Plant (Pantex) would be shipped to the Nevada Test Site (NTS) per current practice. As shown in Table E.1.4–1, data from the DOE Integrated Data Base was used to calculate LLW disposal land usage factors from 1990 to 1993 for Hanford, INEL, SRS, and NTS. To determine a usage factor to use in the waste management impact analysis, an average value was calculated and then rounded down to the nearest hundred cubic meters. For the proposed Class II LLW disposal facility at ORR, a 3,300 m^3/hectares (ha) (1,700 yd^3/acres) usage factor was assumed (OR DOE 1995e:1).

Spent Nuclear Fuel. Spent nuclear fuel from the reactor-based fissile material disposition alternative would be stored within the fissile material disposition facility. The fuel would be kept in water-cooled storage until its decay heat had decreased sufficiently to permit dry storage. Several commercially available options for dry storage have been licensed by NRC, and the facilities required would be relatively small, utilizing a small percentage of the land area required for the fissile material storage and disposition facility. Spent nuclear fuel would not be reprocessed but would eventually be placed in a Federal repository. Spent nuclear fuel is not categorized with nuclear waste, and thus is not included in waste inventories. Since it is radioactive material that must be stored, managed, and handled, it is included here for each site to provide baseline information on its impact on land and facility use.

Table E.1.4–1. Low-Level Waste Disposal Land Usage Factors for Department of Energy Sites

Site	Total Cumulative Volume (m^3)	Estimated Area Utilized (ha)	Land Usage Factor (m^3/ha)
1993			
Hanford	601,610	171.8	3,502
NTS	458,435	174.2	2,632
INEL	147,084	32.3	4,554
SRS	665,239	67.9	9,797
1992			
Hanford	589,506	169.8	3,472
NTS	439,700	55.0	7,995
INEL	145,300	21.2	6,854
SRS	649,700	78.2	8,308
1991			
Hanford	582,800	167.8	3,473
NTS	419,600	55.0	7,629
INEL	145,300	21.2	6,854
SRS	636,700	78.2	8,142
1990			
Hanford	578,900	166.8	3,471
NTS	408,400	No Data	No Data
INEL	144,000	21.2	6,792
SRS	612,800	72.1	8,499
Average			
Hanford	NA	NA	3,480
NTS	NA	NA	6,085
INEL	NA	NA	6,264
SRS	NA	NA	8,687

Note: NA=not applicable.

Source: DOE 1991h; DOE 1992f; DOE 1994c; DOE 1994d.

E.1.5 TRANSPORTATION

The DOE complies with applicable Department of Transportation (DOT) regulations (10 CFR 71 and 49 CFR) when shipping hazardous materials over public roads. Transportation, especially for radioactive material, is highly regulated by Federal, State, and local laws. The stringent packaging requirements, combined with strict regulations and procedures governing the shipment of hazardous and radioactive material, ensure that transport is a safe activity. Federal DOT regulations require the use of appropriate warning placards on vehicles and labels on packages to alert workers, officials, and the public to the hazardous nature of the shipped material. The use of placards on vehicles and warning labels on packages is a joint responsibility of the carrier and the shipper. The labels and placards are familiar to emergency response personnel and are valuable in determining content and hazard information.

Shipments of hazardous materials, including radioactive materials, must be accompanied by properly completed shipping papers such as bills of lading and cargo manifests, which contain detailed information on the material being transported. These papers must be kept in the vehicle transporting the material and must be available for inspection by responsible officials at any time. The shipper must certify on the shipping papers that the hazardous material offered for transportation is properly classified, packaged, marked, labeled, and made ready for transportation according to all DOT regulations.

Radioactive material is shipped in secure packages. Type A packages are designed to contain small amounts of radioactive material and to withstand normal conditions of transport. Type A packages are subjected to rigorous water spray, free-fall compression, and penetration tests carried out in sequence to ensure that radioactive materials are contained. Type B packaging is designed to contain more hazardous, and larger amounts of, radioactive waste. It can withstand severe accident conditions and contain radioactive materials under any credible circumstance. Type B package rigorous testing conditions are discussed in Appendix G.

If WIPP is determined to be a suitable disposal facility for TRU and mixed TRU wastes pursuant to the requirements of 40 CFR 191 and 40 CFR 268, TRU wastes would be shipped in TRUPACT-II (contact-handled) and RH-72B (remote-handled) containers. No remote-handled waste is expected to be generated in any of the fissile material storage and disposition facilities. To determine the number of TRU waste shipments required, 8.7 m^3 (11.4 yd^3) per truck shipment, or if applicable, 17.5 m^3 (22.9 yd^3) per regular train shipment and 52.4 m^3 (68.6 yd^3) per dedicated train shipment was assumed (DOE 1994v:B-4). Transportation by rail may not be applicable at all sites.

As noted earlier, all sites being considered, except Pantex, either have or have planned an onsite LLW disposal facility. The additional shipments of LLW from Pantex as a result of locating fissile material storage and/or disposition functions at Pantex were estimated. All LLW would be transported in a solid form. A typical shipment consists of eighty 208-liter (l) (55-gallon [gal]) drums loaded into an enclosed semi-trailer type truck. Each drum is assumed to be fully loaded, resulting in a total shipment volume of 16.6 m^3 (21.7 yd^3). The truck is assumed to operate as an "exclusive-use" vehicle.

E.1.6 FACILITY TRANSITION MANAGEMENT

Any transition activities of facilities from a production mode to a cleanup mode that are part of the baseline for this PEIS are discussed in the facility impacts section of Chapter 4 and in Section E.2. Decontamination and decommissioning (D&D) considerations of fissile material disposition facilities have been planned for in the design.

The DOE Program Secretarial Officer is responsible for the safe operation, shutdown, and ultimate disposition of facilities used to support his or her program. EM is responsible for final facility disposition, which may include D&D of inactive facilities or refurbishing them for further economic development. Transition activities would require appropriate NEPA evaluation and would proceed consistent with the PEISs within the DOE

Offices of Environmental Management (EM), Defense Programs, and Materials Disposition. Depending on the site, facility transition activities are in different stages of planning. The dominant time-intensive activities are characterizations of the environmental hazards related to the building and the deactivation of the facility.

At the end of their useful lives, all potential facilities would require decommissioning. The transition process begins when DOE management decides to stop operating the facility and ends when responsibility for the facility is formally turned over to EM. Transition plans would be required for all facility transfers to EM. These plans define the actions necessary to bring the identified facilities into a condition acceptable for transfer to EM. Some facility transition issues raised in EM's scoping process for its PEIS, and which would be considered in the facilities design process, are the following:

- Land-use criteria defined for the period after cleanup
- Interim storage of mixed waste and spent nuclear fuel
- Disposal facilities for hazardous and LLW

The cleanup of fissile material storage and disposition facilities would be significantly less difficult because consideration for waste minimization and ease of decontamination would be included in the facility design. The surfaces that come in contact with potential contaminants would be easier to decontaminate. In-process decontamination (to reduce operational exposures) would significantly reduce the cleanup required at the end of life.

In spite of the best design and process practices, many of the fissile material storage and disposition facilities would require decontamination efforts at the end of life. Because of the necessity of working inside contaminated areas during the cleanup phase, the potential for exposure to cleanup workers is higher than during the operations phase. Workers would wear protective clothing and would be supplied breathing air to minimize their exposure.

Technologies for cleanup are established and are improving as experience in working with nuclear facilities increases. The use of robotics, improved task planning, and new materials to prevent the spread of contamination have already improved current cleanup activities. By the time the fissile material storage and disposition facilities are decommissioned, DOE would have gained considerable cleanup experience; thus, further improvements should be expected.